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Circular 20

D E V I C E S F O R I N S E C T C O N T R O L



August 1941

INSECTS IN RELATION

TO

NATIONAL DEFENSE

Circular 20 - Devices for Insect Control

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INTRODUCTION

In general, there are three different types of devices by which insecticides are applied for the control of insects, viz.: (1) sprays, in which water or oil is the carrier for the poison, applied by means of equipment for spraying; (2) dusts, in which some fine powder is used as a carrier, applied by means of dusters; and (3) fumigants, of which there are solid, liquid, and gaseous sources, usually liberated in enclosed spaces such as warehouses or specially devised vaults or fumigation chambers.

Spraying, dusting, or fumigating operations, to be effective, must be timely and thoroughly done. Improper or inadequate application will result in waste of time, effort, and material. When the presence of insects first becomes evident, is the time to apply control measures such as spraying, dusting, or fumigation, as then it is much easier to obtain satisfactory results. It should be remembered at the outset that in applying stomach poisons the aim is to coat thoroughly the entire surface of the material or food upon which the insect is feeding. In the case of contact poisons only those insects that are reached and covered by the insecticide will be killed.

Equipment used should be of sufficient size and power to do the work quickly and satisfactorily, and this is especially true for large scale operations. For spraying and dusting it is important that adequate provision be made for agitation of materials so that they are thoroughly mixed when applied. It is important that all equipment be well cared for as this serves to prolong its life.

Caution: Proper safeguards should be used in the application of all materials and in disposing of any material that may remain unused in the device. All insecticides should be properly labeled, and stored under conditions so they are available only to those responsible for their use and where animals will not have access to them. Many of the insecticides are poisonous to man and animals and should be handled only by those familiar with the hazards that may be involved.

CARE OF INSECT CONTROL DEVICES

Proper care of spraying, dusting, and fumigation equipment is essential to assure satisfactory performance and longer period of usefulness. All equipment should be kept clean, especially when not in use.

Sprayers: Unused spray material should be drained from spray pumps and hose at the completion of a job. The tank, hose, valves, and nozzles should be thoroughly flushed with clean water and the pump run for a few minutes to rinse thoroughly and remove all of the insecticide. Unless this is done, these parts and connections may corrode or become stopped up and fail to operate. Spray equipment should be kept in a cool, shady place to avoid rapid deterioration of gaskets, hose, and other parts. During cold weather the pump should be drained of all excess moisture to avoid freezing and breaking, or it should be stored in a warm place. All unpainted metal parts that are subject to rusting should be well oiled or greased. Wooden tanks should be stored in a damp place or clean water kept in them (except where freezing temperatures occur) to prevent drying out and shrinking.

It is advisable to have extra pump gaskets, hose connections, and similar working parts on hand for prompt replacement should a breakdown in operation occur.

Dusters: Dusters should be kept in a dry place and, if used irregularly, the excess dust should be removed after each operation and returned to the container in which it

is stored. The dust will deteriorate less rapidly in such containers and the mechanism of the dusting equipment will not be subject to corrosion.

SPRAYING EQUIPMENT

The wide range of spraying equipment that may be purchased will meet the needs of almost any kind of insect-control operation. Not all of it is fully satisfactory and care should be used in selecting, to assure that the device will meet the need. Size and type to be used will depend upon the quantity and kind of work to be done. The apparatus selected should always be large enough so that the operation can be quickly and effectively performed. It should be constructed to maintain a pressure sufficient to deliver the insecticide as a mist-like spray, a droplet spray, or a stream that will break into droplets at some distance, as best to meet the particular needs.

Sprayers should be strongly built and of materials, especially all working parts, that will withstand the mechanical wear and the chemical action of the insecticides. Working parts of suitable weight made of brass, bronze, or stainless steel meet these requirements. The apparatus should be designed to permit easy cleaning, repairing, and replacement of the working parts that are likely to wear out quickly.

Among the various types of sprayers suitable for use in and around army camps are: (1) atomizers, (2) vaporizers, (3) compressed air sprayers, (4) knapsack sprayers, (5) bucket pumps, (6) barrel pumps, and (7) power sprayers.

Atomizers

Air-bulb atomizers: This type of apparatus is useful for certain purposes where only a small quantity of material is to be used or limited application is to be made, such as in the treating of a screwworm infested wound with benzol or for applying a fly or mosquito repellent to the exposed portion of the skin. This type of atomizer consists essentially of an air bulb, container for holding the liquid, and a tube and nozzle assembly (fig. 1). The bulb is



Figure 1.--Air-bulb atomizer

usually made of rubber or a rubber-fabric combination, while the liquid container is most frequently of glass. The capacity of this type of atomizer is usually about 1 to 2 ounces.

For manufacturers and distributors, see General Schedule of Supplies of the Procurement Division, Class 57-A; see also Nos. 2, 27, 45, 48, and 61 of list on pages 51-55 of this circular

Hand pump atomizers: This term refers to the group of atomizers which are most often used in pest control. These are adapted to such purposes as spraying in rooms to kill flies and mosquitoes which have gained entrance, applying insecticides to the hiding places of roaches and bedbugs, or other uses where a larger sprayer is not required. They operate on the same principle as the bulb-type atomizer

but the details of construction are different (fig. 2). This type of sprayer is generally made in capacities ranging from a few ounces to over 1 gallon of liquid. Atomizers of brass, galvanized iron, or tin construction are available. Brass resists corrosion better than most

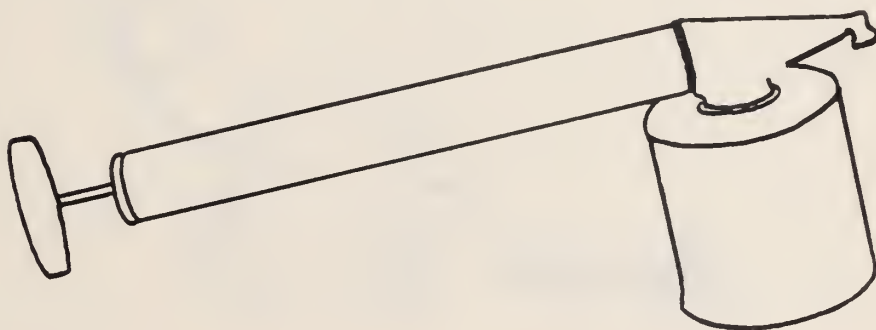


Figure 2.--Hand pump atomizer

other metals and is therefore preferable. To avoid corrosion, screw-top jars or other glass containers for the insecticide instead of sheet-metal reservoirs are very desirable. No provision is made for agitation of the spray but this is accomplished by shaking the atomizer.

For manufacturers and distributors, see Nos. 7, 10, 19, 25, 28, 34, 48, 52, 61, 62, and 92 of list on pages 51-55 of this circular.

Electric atomizers: Atomizers of this type are used in much the same way as the hand pump atomizers. The spray is atomized by a stream of air from a blower. In some cases, the insecticide container and atomizing assembly comprise one unit, while the motor and fan form another (fig. 3) similar to the so-called

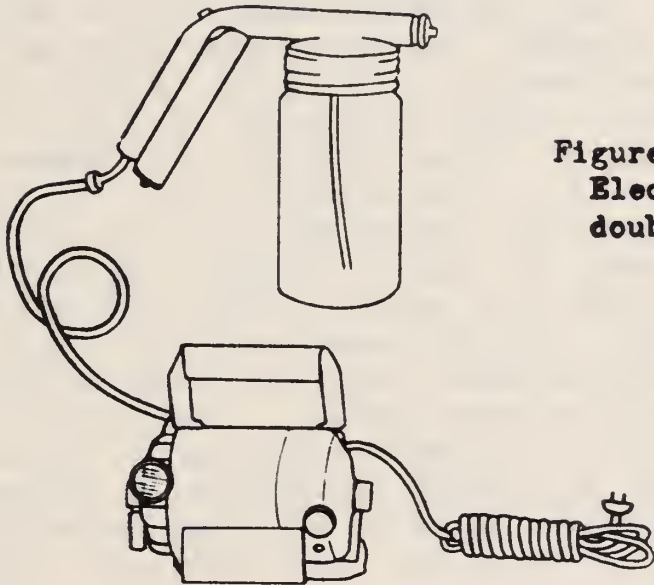


Figure 3.--
Electric atomizer,
double-unit type

paint-gun type. In other cases both units may be combined to form a single piece of equipment (fig. 4). The advantage of the two-unit construction is that the motor and fan can be carried with one hand or placed nearby, thus

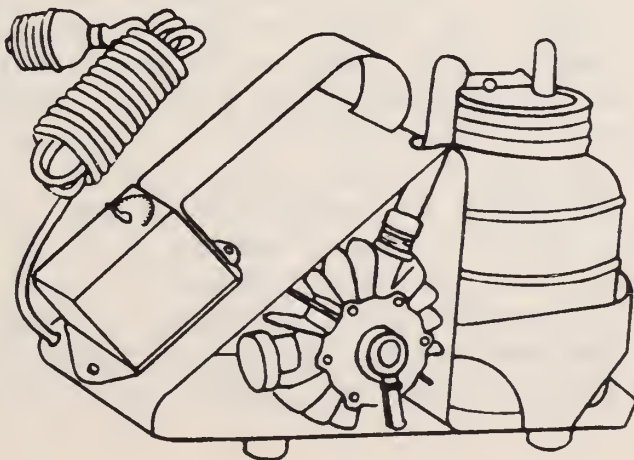


Figure 4.--
Electric
atomizer,
single-
unit
type

reducing the weight and bulk that must be carried by the hand directing the atomizer. The one-unit construction, however, eliminates the necessity of a long air-conducting tube from blower to atomizing nozzle and reduces the number of separate units involved in the operation. The atomizing nozzle may be adjustable so as to provide different rates of application, droplet sizes of spray, or angles at which the spray leaves the atomizer. The container for the insecticidal material may be of either glass or metal construction. Of the metal containers, those made of brass are generally considered most satisfactory. The selection of equipment should be governed by the type of work to be done as well as by the design, construction, and cost of the various kinds.

For manufacturers and distributors of electric atomizers, see Nos. 8, 9, 22, 28, 29, 32, 52, 60, 68, 72, 92, and 95 of list on pages 51-55 of this circular.

Vaporizers

Electric vaporizers or diffusors, as they are sometimes called (fig. 5), are used in applying certain kinds of liquid insecticides in the form of a very fine mist or vapor. An example is the application of an oil-pyrethrum preparation for combating cockroaches (Circular 11). Other uses might include the killing of flies and mosquitoes in offices, clinics, barracks, and other rooms, or for treating kennels, stables, or basements to kill fleas. This type of machine consists essentially of a container for water connected with another for the insecticide and a heating unit. The water is heated

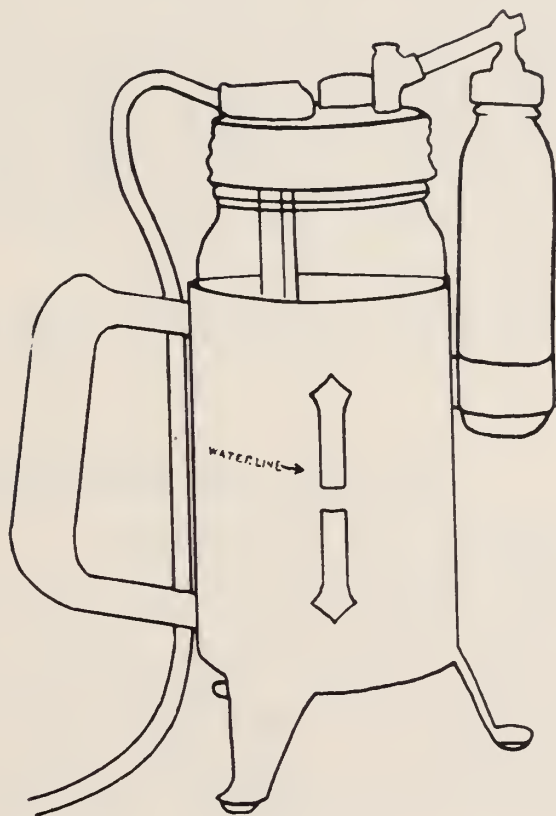


Figure 5.--
Electric
vaporizer,
diffusor
type

to steam which, when discharged, causes an atomizing action similar to that of the atomizers previously discussed. However, the hot steam produces an exceedingly fine mist or vapor which pervades the air and penetrates into very small cracks and crevices.

Some machines of this type are of all-metal construction, preferably of brass or other noncorrosive metal, while others have glass containers for the insecticide or for both water and insecticide. The capacity of such vaporizers varies but is usually small, probably less than a pint of insecticide in most instances, and a larger quantity of water

for vaporizing the material. Obviously, their use is limited to locations where electric power is available. The purpose for which the apparatus is to be used, capacity of apparatus required, ease of operation, accessibility for cleaning or repair, and availability of replacement parts as well as cost are factors to consider when purchasing this kind of equipment.

For manufacturers and distributors of electric vaporizers, see Nos. 9, 44, 60, and 95 of list on pages 51-55 of this circular.

Compressed Air Sprayers

Compressed air sprayers or pumps are useful for applying oil and other larvicides to the surface of mosquito breeding places such as ponds, ditches, and other pools of water to kill the young larvae or wrigglers. They can also be employed for spraying cellars frequented by dogs and cats, or other animal quarters where fleas are likely to be breeding, and for various small-scale operations around camps.

Compressed air sprayers (fig. 6) are usually made of brass or galvanized sheet iron and have a capacity ranging from 1 to 5 gallons. The sprayer consists of an airtight tank into which is clamped a pump. In operation the tank is filled with spray to about three-fourths of its capacity and the opening closed by a tight-fitting cap. Air is then pumped in until the liquid is under sufficient pressure to force it out through the hose and nozzle. The hose is usually fitted with a spray shut-off and a 1- to 5-foot extension rod with nozzle. Since the pressure decreases as the spray is forced out, it is necessary to renew it by further pumping. It often requires three or four pumpings of a

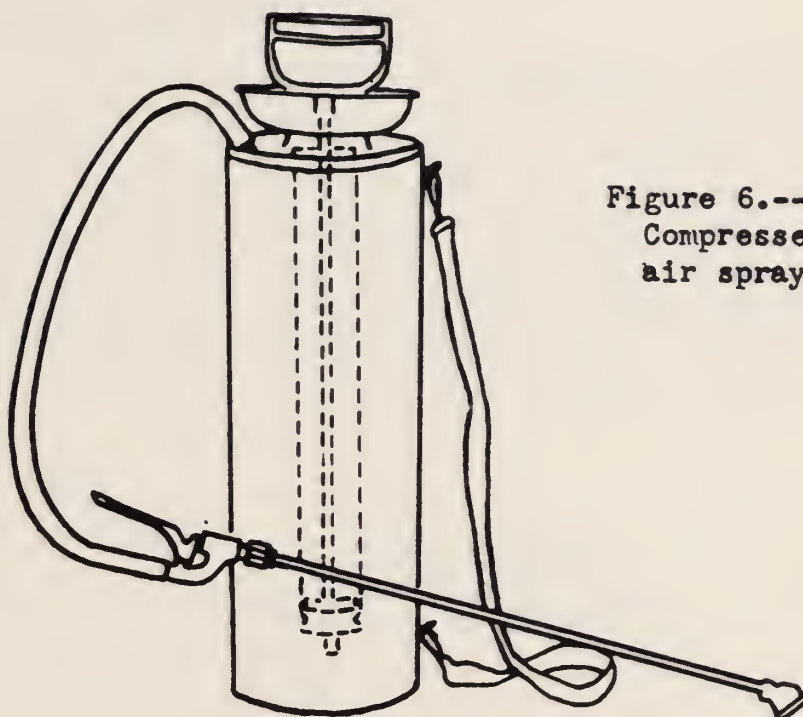


Figure 6.--
Compressed
air sprayer

dozen or more strokes to discharge all of the liquid. Care must be exercised, however, not to pump too much pressure or the tank may burst as a result. The apparatus can be carried by means of a shoulder strap, and can be operated satisfactorily by one person. In some types agitation is provided while pumping by the injection of air at the bottom of the tank. Where no agitation is provided the tank must be shaken frequently to keep the ingredients well mixed, although the movement of the operator causes a certain amount of agitation.

For manufacturers and distributors see Nos. 2, 3, 8, 9, 10, 27, 28, 37, 43, 44, 52, 55, 68, 75, 91, 92, 93, and 104 of list on pages 51-55 of this circular.

Knapsack Sprayers

The usefulness of knapsack sprayers corresponds closely to that of compressed air sprayers in that they may be used for treating small areas such as mosquito breeding pools, flea-infested basements, stables, and dog kennels, or for applying insecticides in the control of roaches and other pests where the use of larger apparatus is not economical. A knapsack sprayer (fig. 7) consists essentially

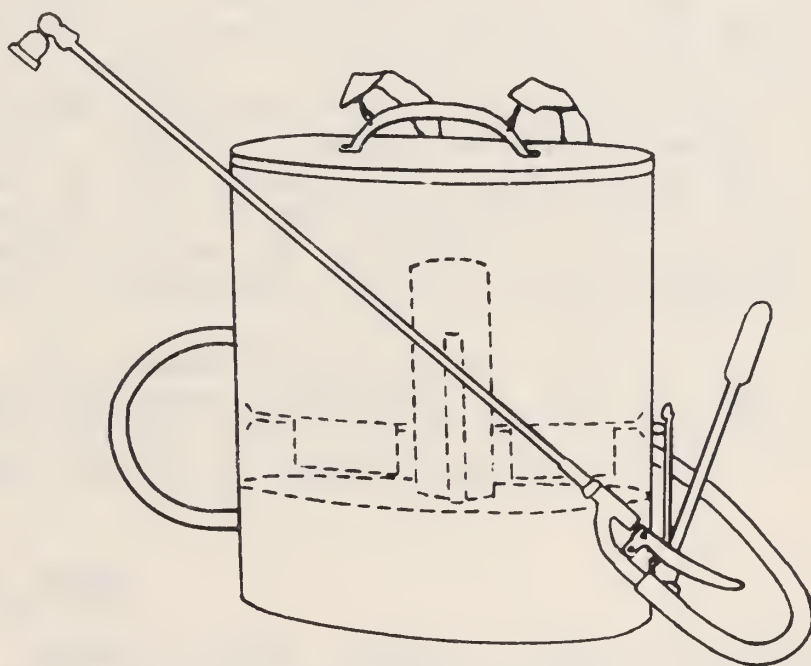


Figure 7.--Knapsack sprayer

of a force pump with an air chamber fitted to a metal tank and so designed that it can be carried on the back of the operator. It can be operated by one hand while the other is used to manipulate the hose, spray rod, and nozzle with

which the apparatus is equipped. Knapsack sprayers have a capacity of about 3 to 5 gallons and a spraying range of about 25 feet when equipped with a nozzle throwing a compact stream of spray. An outstanding advantage of this type over the bucket or barrel type pump is that the operator may move from place to place while spraying. It has an advantage over the compressed air sprayer in that a high and uniform pressure can be maintained when the pump is kept in constant operation. Agitation is provided in some outfits by a brass plate inside of the tank which moves up and down with the pump handle. Some of the disadvantages are that these sprayers are tiring to operate for extended periods, because of their weight when carried on the shoulders. Also, they may cause discomfort due to the slopping of the spray and the condensation of moisture on the outside of the tank, especially in hot, humid weather.

For manufacturers and distributors of knapsack sprayers see Nos. 7, 10, 18, 28, 37, 43, 52, 65, 66, 67, 75, 86, 92, and 104 of list on pages 51-55 of this circular.

Bucket Pumps

Bucket pumps (fig. 8) may be used in the same manner as are the compressed air or knapsack sprayers for applying insecticides to the surface of small bodies of water to control mosquito larvae, for spraying flea-infested places such as basements and kennels, and in various other situations where limited quantities of insecticide are to be used. However, they are not so well adapted for general use as are the knapsack sprayers. Bucket pumps may be clamped to any bucket or container to make them steady, or used free in a tub or other vessel

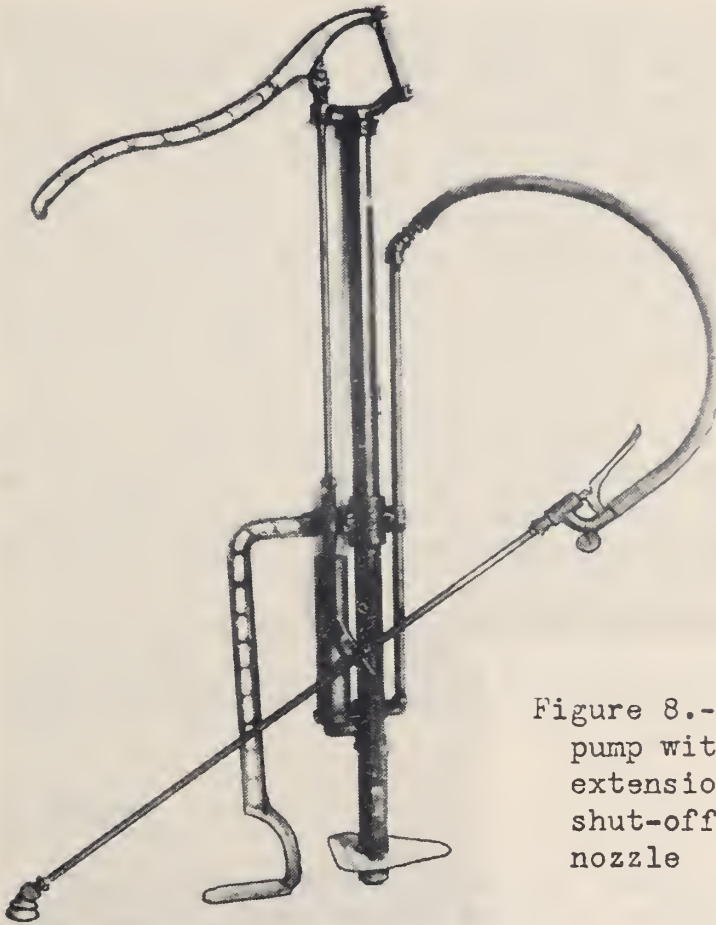


Figure 8.--Bucket pump with hose, extension rod, shut-off, and nozzle

containing the insecticide. They should be of brass or other noncorrosive metal, should have a large air chamber and preferably be equipped with an agitator. In some pumps agitation is provided by means of a small jet of liquid which squirts from the bottom of the pump into the spray tank or container as the pump is operated. In other models a brass plate attached to the handle furnishes satisfactory agitation. Some kinds of bucket pumps are single-acting, i.e., they force liquid on the

down stroke only, whereas the double-acting pumps discharge liquid on both up and down strokes. They should be equipped with a spray rod, nozzle, and enough hose to facilitate spraying. Bucket pumps are used with vessels of varying capacity but usually one of 2 to 5 gallons capacity is quite satisfactory. A disadvantage of this type of sprayer is that the operator cannot move about so freely as is possible with the compressed air and knapsack types which can be carried around. This is especially true when bucket pumps are operated by two persons with one at the pump and the other at the nozzle. They have the advantage of greater durability and ease of cleaning.

For manufacturers and distributors see Nos. 3, 7, 10, 13, 28, 43, 49, 52, 67, 75, 92, and 104 of list on pages 51-55 of this circular.

Barrel Pumps

The hand operated barrel pump outfit (fig. 9) is an efficient type of sprayer to use in certain situations as where the soil around foundations of buildings is to be saturated with poisons to kill termites, where relatively small mosquito breeding areas are to be treated, or for spraying stables and storerooms. Barrel pumps may be employed to advantage where large quantities of liquid insecticides are to be used and cannot be applied economically with the smaller types of hand sprayers. These pumps usually have a capacity of about 50 gallons and should be so constructed that an operator can maintain a pressure ranging from 125 to 175 pounds with one discharge pipe in use.

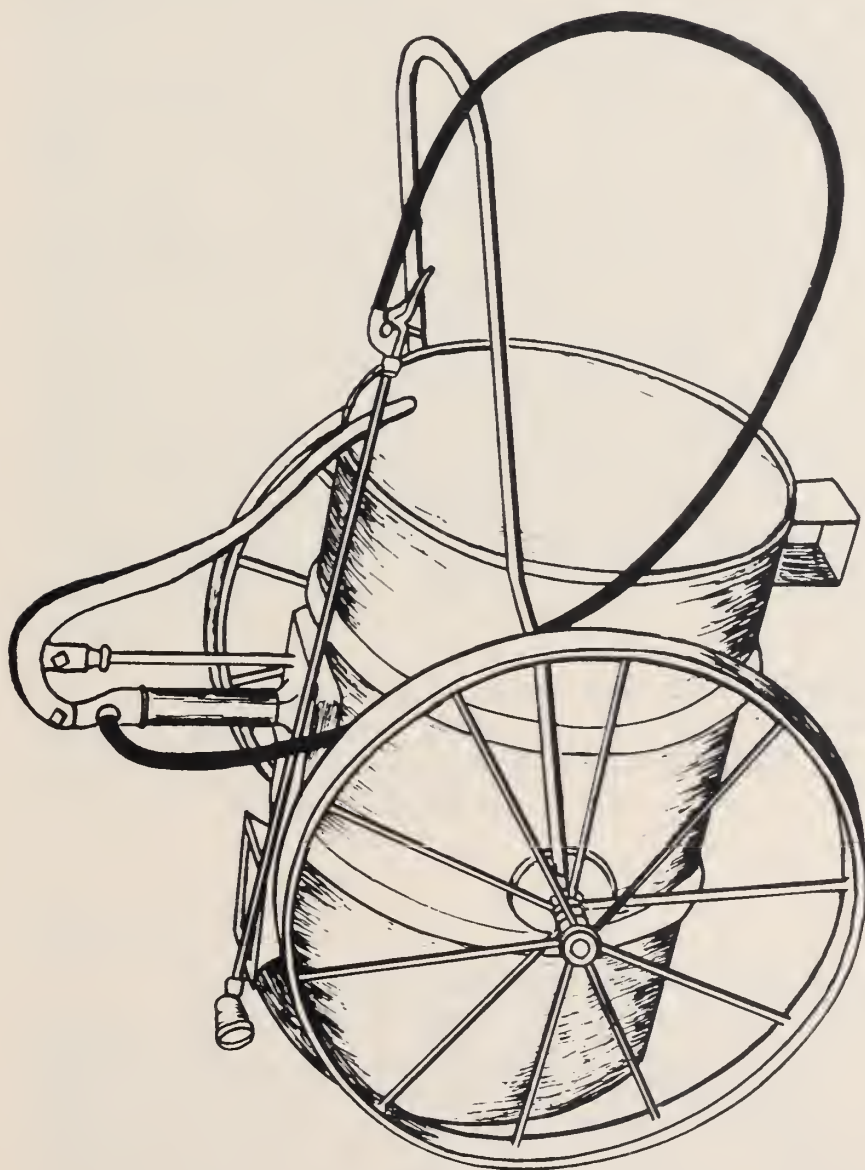


Figure 9.--Barrel pump on wheels and equipped with hose, extension rod, shut-off, and nozzle.

To maintain a good pressure and uniform discharge of the spray material, the pump should be provided with an adequate air chamber located preferably in the barrel and not projecting above the top. A pressure gauge may be attached to the air chamber so the pressure that is being developed can be read easily. The working parts should be of bronze, brass, or other noncorrosive material and the valves and plungers should be readily accessible and easily repaired. The pump should be provided with an efficient agitator, of either the paddle or rotary type. The pump may be mounted either on the head or on the side of the barrel and the whole outfit placed upon wheels or skids or upon a wagon, truck, or flat-bottomed boat. It is preferable to mount the barrel in a horizontal position with the pump on the side since this lowers the center of gravity of the outfit.

For manufacturers and distributors of barrel pumps, see Nos. 3, 7, 10, 13, 28, 43, 49, 52, 67, 75, 92, and 104 of list on pages 51-55 of this circular.

Power Sprayers

When extensive spraying of stables, barracks, mess halls, kitchens, or outdoor meeting places is required, the use of some kind of power sprayer is recommended. A power outfit (fig. 10) of suitable size may also sometimes be effectively used in the treatment of mosquito breeding areas where conditions permit. The kind of sprayer to be used will depend on various factors including extent, type, and condition of area to be covered, and time and labor available for application.

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Figure 10.--Power sprayer used in large scale mosquito control operations

The principal parts of a power sprayer are the power unit, pump, pressure regulator, and tank. In general, the outfit should combine strength and durability with minimum weight. It should be simple and compact in design with all wearing parts made of the best materials and readily accessible for adjustment, repair, or replacement.

Power outfits are driven either by a gasoline engine or by an electric motor. The former can be used anywhere the sprayer can be taken,

while the latter can be used only where electric power is available. Some power sprayers are available with either a gasoline engine or an electric motor at the choice of the purchaser, while others may be obtained without a power supply and a suitable engine or motor attached later.

The power required to operate a sprayer will depend on various factors of construction and operation. For small outfits delivering about three gallons of spray or less per minute and working at pressures not to exceed 300 pounds per square inch a power supply of 1 to 2 horse power is generally required. Large outfits delivering a maximum of 25 gallons per minute under pressure of about 600 pounds per square inch are usually furnished with a gasoline engine of about 14 horsepower.

Spray pumps which form a part of a power sprayer increase in size and capacity, as a rule, with the over-all size of the outfit. Small power rigs are usually fitted with two-cylinder (duplex) but sometimes only one-cylinder pumps. When one-cylinder pumps are used there is always greater danger of insufficient spraying capacity and a less uniform pressure. Larger outfits have three-cylinder (triplex) or four-cylinder (quadruplex) pumps.

Pumps in which the cylinders or plungers are driven by a crankshaft coupled to the engine or motor, are widely used. These give good service when well constructed and are usually easily accessible for repairing. Some manufacturers use an eccentric arrangement for driving the cylinders and others a Scotch yoke. One- and two-cylinder pumps are sometimes actuated by a walking beam arrangement.

A sprayer should not be expected to perform at its maximum rated capacity. This would place an undue strain on the working parts and result in excessive wear and tear on the machinery. The engine tends to slow down as wear increases on it, with an accompanying slow-down of the rate at which the pump operates. Wear on the pump itself accounts for further reduction in the rate of discharge of spray. Worn valves and pistons or leaky plungers and corroded or dirty, clogged screens also cause a reduction in efficiency. Dirt such as leaves, twigs, or other materials may also affect the operation of the sprayer. For these reasons an outfit of sufficient capacity rating should always be obtained.

It is essential that some provision be made to prevent the spray pump from building up a pressure that would burst the sprayer or hose connections or stall the engine. The manufacturer therefore provides a by-pass in the sprayer by means of which the liquid is returned to the spray tank when the pressure reaches a certain level. The most satisfactory arrangement consists of an assembly called a pressure regulator which is located between the spray pump and spraying attachments. Relief valves have been used but in general have not been so satisfactory in operation and durability as the pressure regulators. However, the relief valve arrangement is used in some of the small power outfits with reasonably satisfactory results. Relief valves and pressure regulators differ in several ways in favor of the latter because of the differences in operating principles.

The tanks on power spray outfits are usually made of cypress held in place by metal bands. Metal tanks are not so satisfactory unless made of some noncorrosive metal.

The framework holding the tank, pump, and engine should be made of steel, preferably, so as to give adequate support to the weight that must be carried.

A mechanically operated agitator is usually provided in the tank and serves to keep the insecticide well mixed during spray application. Some spray outfits are made with compartment tanks and arranged so that the mixing of the ingredients is done as the spray is applied. Other rigs are designed so that the water may be drawn from a pond or lake and mixed with the insecticidal agent while spraying. The latter arrangement might be desirable when spraying on or near bodies of water as for the control of mosquitoes.

A copy of United States Department of Agriculture Specification No. A-FPS-g-641 describing heavy duty power sprayers ranging in capacity from 10 to 60 gallons per minute may be had upon request.

For manufacturers and distributors of power sprayers see Nos. 7, 12, 25, 28, 37, 38, 41, 43, 49, 75, 79, 97, and 104 of list on pages 51-55 of this circular.

Motorcycle Spraying Equipment

A modified-sidecar motorcycle has a limited range of use but is particularly economical where this type of equipment is indicated, as in treating inlets and catch basins of a sewer system where a large number of locations require regular treatment to kill mosquito larvae.

The sidecar is attached on the left side of the motorcycle and is equipped with a hinge-covered compartment large enough to accommodate a welded steel tank 18 inches in diameter and 32 inches long. A tank of this size should not be filled with more than 30 gallons of insecticide so as to have sufficient space for air pressure. Two steel bands welded to the tank and bolted to the wall of the compartment hold the tank firmly. It is fitted with an air pressure gauge, an air release petcock, an air inlet valve, a 1-1/2 inch brass filler plug, and a 3/8 inch brass outlet pipe with globe valve and hose connection. A trigger valve extension rod and spray nozzle are attached to the hose. The operator drives to each catch basin to treat the water it contains. The spraying outfit should be operated at about 50 pounds pressure.

Spraying Accessories

A spraying outfit is not complete and efficient unless properly equipped with useful and necessary accessories. Spraying to be effective must often be done at critical periods and delays caused by insufficient or inferior equipment may result in serious

losses. It is necessary, therefore, to provide spraying devices that will save time and aid in doing more thorough work. Among the essential accessories that may be needed for certain purposes are spray hose, spray rod extensions, spray nozzles, spray guns, spray shut-offs, hose couplings and clamps, pressure regulators, extra parts, and tools. Other handy devices that should be kept on hand are suitable scales for weighing the insecticides, galvanized buckets, and strainers.

Spray hose: It is advisable to use a good grade of high pressure hose for large scale spraying operations. The durability of a hose does not depend so much upon the number of plies as it does on the quality of both the rubber and the fabric ply or braided cord that are used in its manufacture. The ply consists of several layers of fabric incorporated in the rubber wall to give support against high pressure and wear. The inner surface should preferably be made of insecticide-resistant material. The weight of spray hose increases rapidly with the increase in diameter. In general, it is desirable to choose lightness in weight when it is consistent with durability.

Usually as the size and capacity of the spray outfit and the length of hose lead increases, the need for a good hose also increases. The hose pressure of hand outfits does not as a rule exceed 150 pounds, while that of high power outfits ranges from 150 to 400 pounds pressure, with an average of 200 to 300 pounds. Some heavy duty power sprayers will develop pressures of 1,000 pounds or more. It is important to use a hose which will withstand the pressure developed by the spray apparatus.

For some hand apparatus the cheaper grades will often be satisfactory if replaced frequently. The cheaper grades, however, do not meet the requirements of lightness and durability.

It is advisable to use a hose with the smallest possible diameter that will meet the requirements of the duty for which it is intended. For small hand sprayers of the compressed-air type a hose ranging from $1/4$ to $3/8$ inch in inside diameter is satisfactory. For the barrel type and somewhat larger hand-operated spray outfits a $3/8$ to $1/2$ inch diameter hose should be used. Power-operated sprayers usually require a hose that should have a diameter of $1/2$ to $3/4$ inch and be of 4- to 7-ply construction. Braided cord hose is recommended for use with extra heavy duty sprayers.

Spray hose is usually obtainable in lengths of 25 and 50 feet, although it can be purchased in almost any length to suit the need.

With ordinary good care the average length of life of a hose is from 5 to 8 or more years, depending upon the quality. After each spray operation it should be cleansed by flushing with clean water, otherwise the insecticide will soon ruin a good hose. Insecticides such as lime sulfur damage the fabric or cord more than the rubber. Oil-containing sprays, on the other hand, affect the rubber readily. Breakage or leaks can be greatly reduced by not allowing kinks to form and by not driving the spray rig over the hose. Hose should be stored in a cool, dark place when not in use, and hung up on a broad support rather than on nails. Heavy-grade hose should not be coiled when stored but stretched out in straight lengths.

Spray nozzles: Sprays are usually applied by means of an extension rod attached to the end of a spray hose which is equipped with one or more nozzles depending upon the extent of the spraying to be done. In some instances the nozzle may be attached directly to the spray hose. Various types of nozzle as described below are available.

Disk nozzle. This is among the more useful small-capacity nozzles now in use. This nozzle consists of a metal base containing an eddy or whorl chamber formed from two disks separated by a gasket and held in place by a metal cap (figs. 11 and 12). The spray material enters the eddy chamber at an angle which causes the liquid to whirl

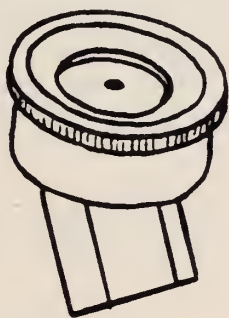


Figure 11.--
Disk nozzle,
angled type

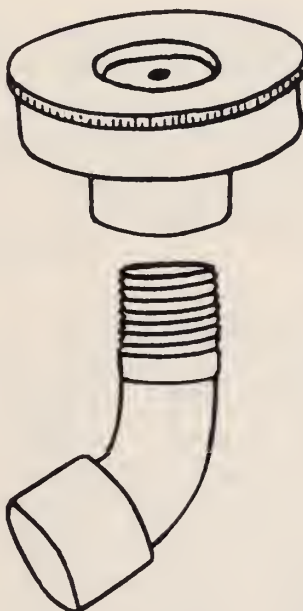


Figure 12.
--Disk
nozzle,
straight
type, and
elbow

rapidly. The spray escapes through a small hole drilled in the center of the thin disk that covers the outer end of the whorl chamber. This nozzle produces a hollow, cone-shaped spray, although some nozzles have been designed

to produce a more or less solid cone. The disks are removable and can be changed when they become worn or whenever desirable. Disks containing holes of various sizes are obtainable, thus permitting the use of the size best suited to a particular spray, or to the capacity of the apparatus with which it is to be used. The disks with large holes deliver the larger quantities of material and should not be used with pumps of small output and pressure capacity such as small hand sprayers. Being small and compact, this type of nozzle is handy to operate among vegetation and does not easily become entangled in the branches of bushes or undergrowth.

Disk nozzles are usually made either straight or angled. The angled nozzle (fig. 11) delivers the spray at an angle to the hose or spray rod and is convenient for most spray work. An angled-nozzle assembly as shown in figure 12 can be made by attaching an elbow or crook to a straight nozzle.

Vermorel nozzle. The original whirlpool nozzle is generally known as the vermorel nozzle (fig. 13). The modern type is so constructed that it is provided with a degorger for use in cleaning the nozzle when clogged. This nozzle gives a very fine, misty spray with low pressure and can therefore be used to advantage with spray pumps of small capacity. This type is now available singly or in clusters of

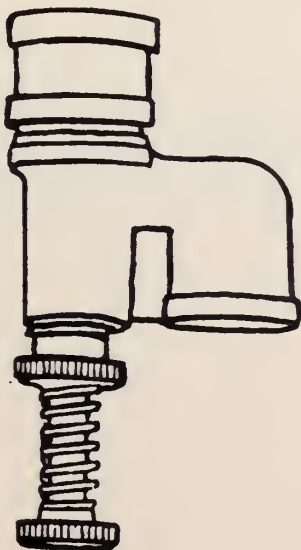


Figure 13.--Vermorel nozzle

2, 3, or 4 nozzles. The clusters, however, are troublesome in that they easily become entangled in thick vegetation or heavy undergrowth.

Bordeaux nozzle. In this type of nozzle (fig. 14), the stream is broken by a beveled internal obstruction which may be adjusted to give a relatively fine fan-shaped spray or a

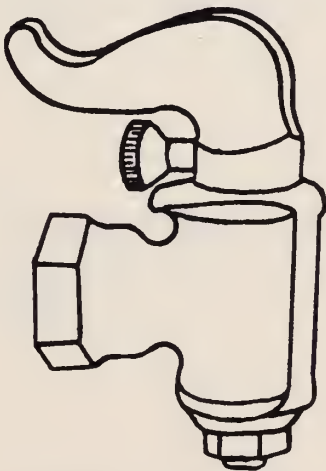


Figure 14.--
Bordeaux nozzle

solid stream, with all gradations between. Bordeaux nozzles do not easily clog and may be quickly freed from coarse spray particles or other sediment by turning the barrel by means of a small handle on the side of the nozzle. These nozzles deliver a large quantity of material, and in order to insure a satisfactory spray the pump must have ample capacity to maintain a high pressure. They wear quickly, however, when used under high pressure. Since they

deliver the spray with considerable force against the object being sprayed, they may be used to advantage when a forceful spray is desired. This type is not used so much as formerly.

Spray rod extensions: Extension or spray rods may be advantageously employed in applying oil to water pools, in mosquito control, or in spraying basements to control fleas, and in other situations that are otherwise inaccessible or difficult to reach. Spray rods are made in various lengths, generally of brass or aluminum construction. Small hand outfits are usually provided with extension rods varying from $1\frac{1}{2}$ to 3 feet in length as shown in figure 15. Lengths of

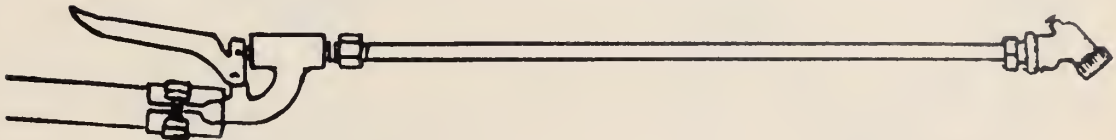


Figure 15.--Spray rod extension with nozzle and automatic shut-off

from 6 to 12 feet are usually contained within a bamboo pole to provide added strength. Ordinary gas piping may be used in an emergency but the lighter-weight spray rods are preferred.

Spray shut-off: Large power sprayer outfits should be provided with a spray shut-off, of either the single (fig. 16) or the double type (fig. 17), on the discharge line at the pump, in order to permit the making

of adjustments, repairing of leaks in the hose or couplings, and unclogging of nozzles. A shut-off also prevents waste of material when moving the apparatus from place to place and permits the running of the engine to provide agitation for mixing sprays when filling the

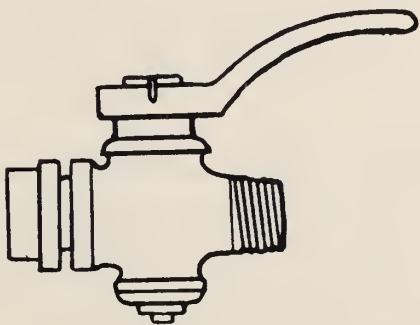


Figure 16.--
Spray shut-off,
single type

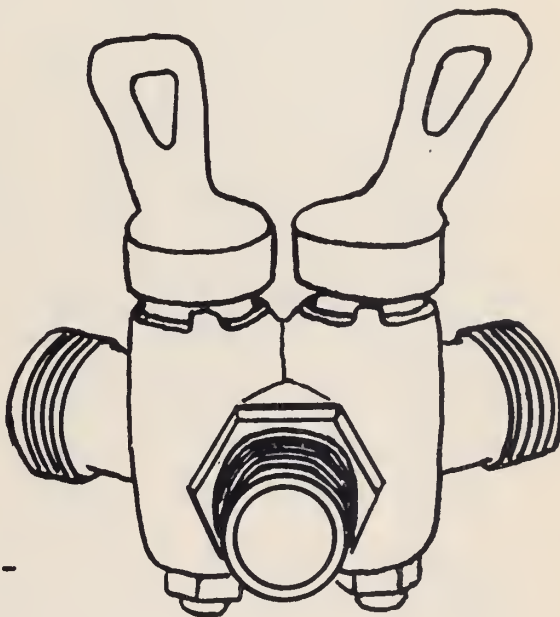


Figure 17.--Spray shut-
off, double type

tank. It is convenient also to have a shut-off installed between the spray hose and the base of the spray rod. Many of the small hand outfits as the compressed air sprayers and the like are equipped with such a shut-off, as in figure 15.

Factors to consider when purchasing a shut-off are ease, quickness, and completeness with which the spray liquid can be cut off under pressure. In general, shut-offs should be made of noncorrosive metals such as brass, to withstand the chemical action of the sprays. Repacking of types that need it should be done at frequent intervals to avoid unnecessary wear on the shut-off.

There are various types of shut-off now available to suit almost any need including the throttle, plug valve, globe valve, ball valve, and angle valve types. In the lever type the liquid is cut off with a quarter turn in either direction. It operates very easily and shuts off the spray quickly with no leakage if kept well packed. The globe valve is slow in cutting off the spray since it takes several turns to close and frequent repacking is required. The ball valve type opens faster than the globe valve type in that it requires less than a full turn. Because of the revolving ball on the valve it will not leak due to wear, but sediment collects at times between the ball and the valve seat. The angle valve is so constructed as to permit the hose to hang in its natural position and thus reduces somewhat the wear on the hose at the coupling. It shuts off or releases the flow of the spray quickly and is easy to operate.

Nozzle Y: With spray apparatus of sufficient capacity and pressure, the spraying operation may be speeded up by using two nozzles on a rod. These can be attached to the spray extension or rod by the use of a Y. The Y's are made straight for angle nozzles or curved for straight nozzles and should be made preferably of brass.

Hose Couplings and Clamps: Heavy brass couplings and clamps should be used in preference to lightweight ones, for greater security against breakage. Fittings for various types of high pressure hose are generally available.

Pressure Gauge: Pressure gauges (fig. 18) are a necessary adjunct in power spray outfits. The range used will depend upon the pressure capacity of the sprayer. Usually pressure gauges are available in capacities ranging up to 500 pounds or more. Ordinarily a power sprayer is supplied with the proper pressure gauge attached as a part of the equipment.

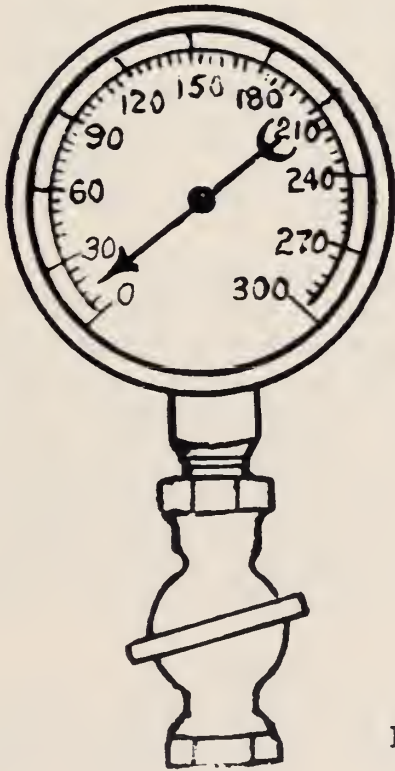


Figure 18.--Pressure gauge and cut-off valve

For manufacturers and distributors of spraying accessories, see Nos. 7, 27, 28, 37, 41, 43, 44, 49, 52, 75, 92, and 104 of list on pages 51-55 of this circular.

DUSTING EQUIPMENT

Equipment of various types and styles and adapted to a wide range of use for applying insecticidal dusts is available on the market. As in the case of sprayers, a good duster should be capable of discharging the dust material in such a way as to place a uniform coating over the object or area to be treated. Dusting apparatus is generally classed into hand dusters and power dusters.

There are three types of hand dusters available and their operation is based upon the manner in which the air force for delivering the dust is developed, i.e., whether of the plunger type, the bellows type, or the rotary fan type. For use in insect control operations in army establishments any of these types can be used to advantage depending upon the nature of the operation for which they are to be employed.

In general, power dusters are of the rotary fan type but of larger capacity than the rotary hand duster, and are powered by a gasoline engine.

For treating extensive areas of marshes and streams with paris green to control malaria mosquito larvae, dusting by means of airplanes has been found to be a satisfactory method.

Plunger Type Duster

The plunger type of hand duster (fig. 19) consists of a chamber for the insecticide and a cylindrical metal chamber provided with a piston, piston rod, and handle. When the handle is operated back and forth an air blast is developed that passes through the second

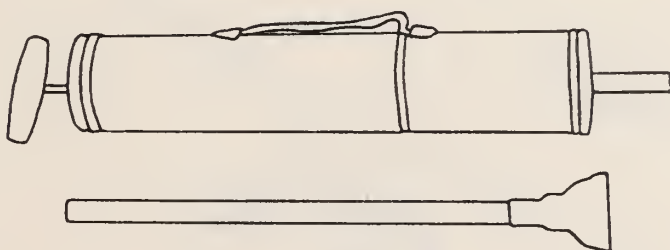


Figure 19.--
Plunger
type
of hand
duster

chamber containing the insecticidal dust. In some types the pump and the dust chamber are made entirely of metal, whereas in others the dust container is a glass mason jar, which is threaded so that it can be screwed into the pump chamber. These usually have a capacity of about 1 to 2 pounds. They are especially useful for applying small quantities of dust to rooms and kitchens as in the control of roaches, for treating latrines, or for blowing calcium cyanide into rat holes.

Many cheap types are available which are not very durable because of weak construction of the plunger or poor soldering of the plunger chamber to the compartment holding the insecticide. For this reason it is well to purchase a sturdier make constructed of heavy metal.

For manufacturers and distributors see Nos. 2, 10, 15, 28, 35, 36, 43, 51, 52, 61, 65, 66, 67, 79, 80, 86, 87, and 92 of list on pages 51-55 of this circular.

Bellows or Knapsack Type Duster

The bellows type duster (fig. 20) can be used advantageously in treating mosquito breeding places when it is impractical to use power equipment or airplane, or around barracks

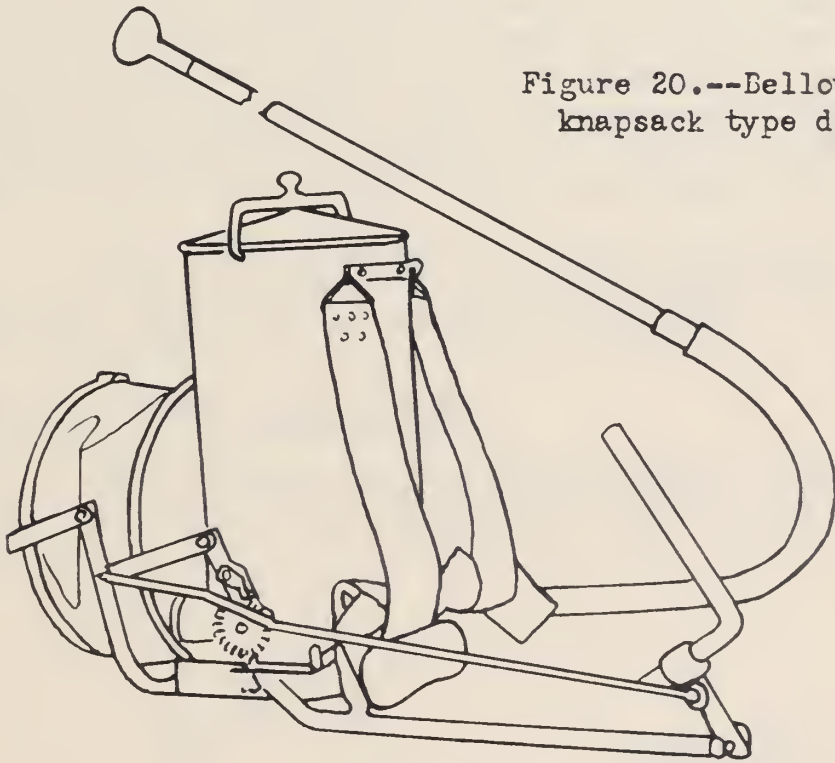


Figure 20.--Bellows or knapsack type duster

and stables where larger equipment would be difficult to operate. Essentially the bellows type duster consists of a metal container or hopper for the insecticide, equipped with a bellows which when operated forces the air through a discharge chamber and pipe carrying

the insecticide with it. The hopper is usually provided with a dust-feeding device. The dust is discharged in puffs with each stroke instead of in a continuous stream of dust as is the case with the blower type. This kind of equipment is especially well adapted for so-called "spot" dusting or where it is necessary to drive insecticides into cracks and crevices with slightly more force than is obtained with a rotary type duster. These dusters are so constructed that they can be strapped to the back of the operator like a knapsack. When in use, one hand operates the bellows lever, while the other directs the discharge pipe.

For manufacturers and distributors, see Nos. 43, 51, 65, 66, 80, 86, 94, and 104 of list on pages 51-55 of this circular.

Fan or Blower Type Duster

The rotary fan or blower type duster (fig. 21) is a very convenient and easily

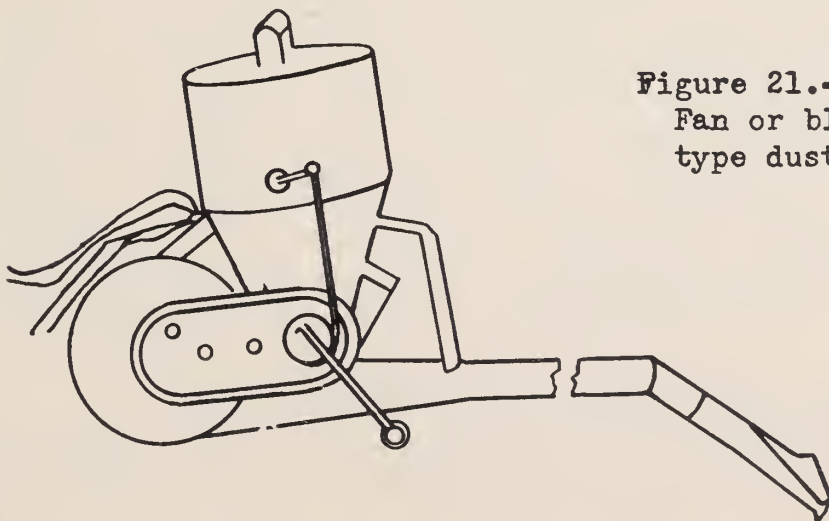


Figure 21.--
Fan or blower
type duster

operated apparatus for use in situations similar to those described for the bellows or knapsack duster. Since it delivers a continuous stream of dust while in operation, it is perhaps even more desirable for treating marshes where greater uniformity of application is needed.

In this type of duster the hopper, which has a capacity of 5 to 10 pounds, depends upon the powder used, is usually located over the air chamber. An enclosed fan operated by gears from a hand crank forces an even and continuous flow of air through a small chamber into which the dust is fed from the hopper. Most modern types are equipped with an agitator that will keep the dust stirred within the hopper and also with an adjustable feeding device to insure an even feed through the discharge chamber. The gears should be made of steel, machine-cut, and should operate in grease in a dust-proof gear case. Since the rapidly moving parts wear out quickly, they should be constructed so they can be removed easily for repairs and cleaning. The outer casing of the duster, including the delivery tubes, should be of as light construction as possible without sacrificing durability. This type of duster can be fastened to the operator by means of a body support, waist and shoulder strap. The discharge pipes of some are designed so that dusting can be done in front or to the rear of the body. Elbows, branches, and adjustable nozzles to meet varying conditions of application are also procurable.

For manufacturers and distributors see Nos. 28, 43, 52, 67, 71, 79, 82, 87, 90, 92, and 104 of list on pages 51-55 of this Circular.

Power Dusters

Large dusters operated by gasoline engines as used for orchard dusting may be adapted for treatment of mosquito infested areas in lagoons or lakes where such areas can be reached with a boat or raft bearing the equipment. Such equipment is usually operated by a 4 to 10 horse power gasoline engine. The essential parts are the hopper, feeder, air chamber, fan, and discharge tube. The dust mixture is carried in the hopper, from which it is fed into the air chamber, where it is caught by a strong current of air generated by the rapidly revolving fan and is forcibly expelled through the flexible discharge pipe. These outfits are provided with a clutch so that the duster may be disconnected from the engine. The apparatus should have an agitator to keep the dust well stirred so that it will not cake and clog. A mechanism should be provided for regulating at a uniform rate the quantity of dust fed into the discharge chamber. Some outfits are now equipped with a self-contained mixing device. Dust materials of the proper proportions are poured into the hopper and are thoroughly mixed before being discharged.

For manufacturers and distributors see Nos. 4, 7, 41, 43, 70, 71, 79, 81, 87, 90, and 104 of list on pages 51-55 of this circular.

Dust Mixers

Some kind of mixer is required for the preparation of insecticidal dusts. Small quantities may be put in a round can or keg fitted with a tight lid, and mixed by rolling the container on the floor for several minutes. A few stones about the size of hen eggs or a little larger placed in the can help to mix the ingredients thoroughly.

Dust mixers are available in various sizes of both hand-operated and power-operated types. They consist essentially of a hopper equipped with paddles or spiral blades which revolve. Some have two hoppers (fig. 22), one provided with a sifter which breaks up any lumps and a second where the mixing is completed.

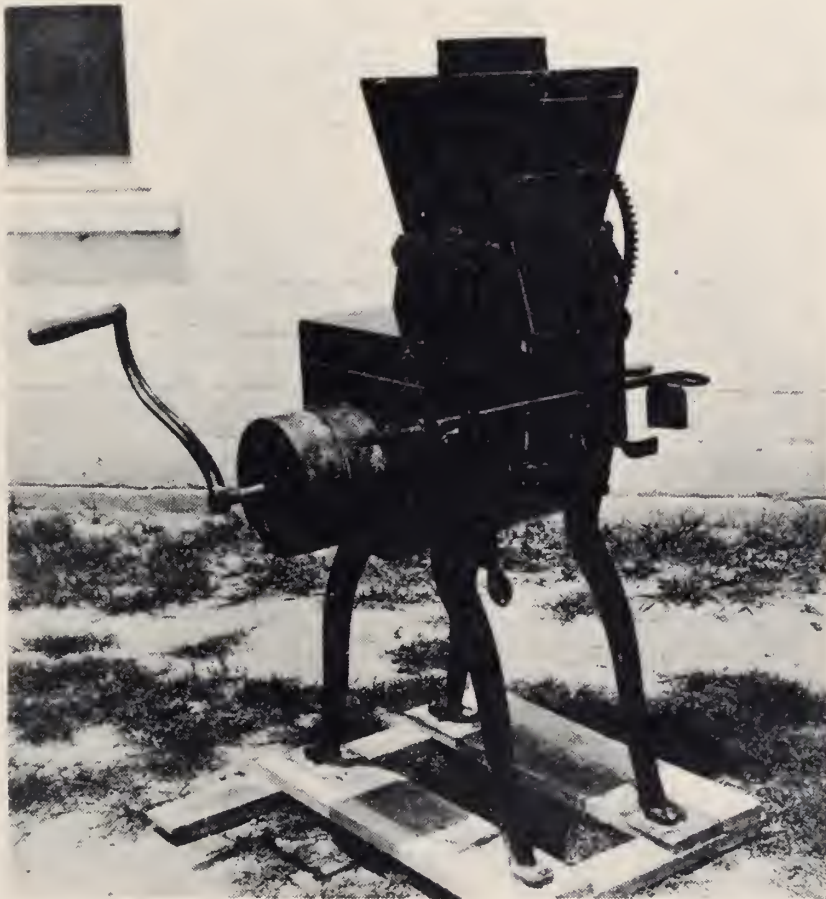


Figure 22.--Dust mixer

For manufacturers and distributors of dust mixers see list, Nos. 1, 4, 24, 43, 71, 79, and 82 on pages 51-55 of this circular.

AIRPLANE SPRAYING AND DUSTING

Application of dusts or sprays by airplane or autogiro for insect control around military reservations or cantonments would most frequently be made for controlling mosquitoes. This method of applying insecticides might be desirable when extensive mosquito-breeding areas are to be treated, when it is necessary to treat a given area in as short a time as possible, or when it is impossible or very difficult to apply the insecticide by other methods.

The airplane used for spraying and dusting operations should be especially constructed to embody slow flying speed of about 80 to 120 miles per hour, great maneuverability, good load capacity, and a tight fuselage to protect the operator from the insecticide. It is possible to convert a two-seater plane into a dusting airplane by installing a hopper and the required attachments.

The essential features of dusting equipment for installation in airplanes are the dust hopper and dispensing mechanism (fig. 23). The dust hopper should be of as great capacity as practicable and located as near the center of gravity of the plane as possible. To insure satisfactory feeding of the dust into the dispenser, the hopper should be fitted with suitable agitators. The dispensing mechanism most often used is the Venturi tube. It consists of a rectangular metal tube converging from each end toward the middle and mounted lengthwise under the fuselage so that the slip stream from the propeller causes a turbulence in the rear portion of the Venturi. An adjustable slot controlled from the pilot's cockpit for feeding the dust into the tube from the hopper

is provided at the constricted place in the Venturi. The dust is dispersed by the action of the air turbulence in the tube and the slip stream of the plane.

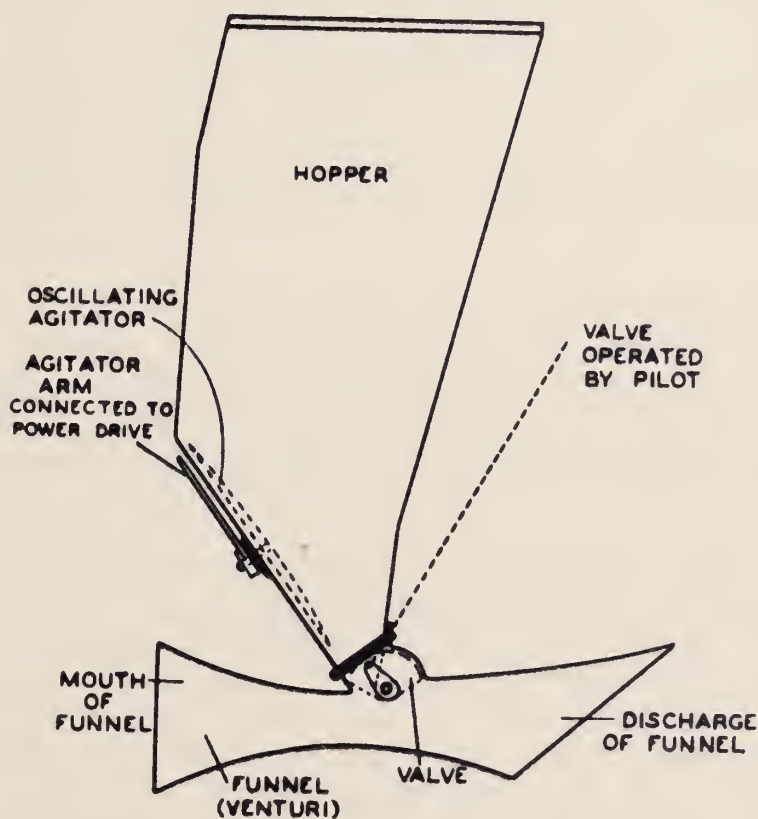


Figure 23.--Dust hopper and Venturi funnel for airplane dusting

Several methods may be used to apply liquid insecticides, chiefly oils, from airplanes. The Venturi tube may be used for the application of liquids. Another method consists of a simple pipe system leading from

the supply tank to lateral pipes at the tail of the plane. The liquid flows by gravity and is broken up and distributed by air turbulence at the rear of the plane. A third type of mechanism consists of two or more rotary pumps mounted on the wings of the plane, each driven by a small wind-actuated propeller. The pumps throw the liquid into the slip stream which provides further dispersion. It is important that feed lines, pumps, valves, and other fittings be of sufficient size to permit the delivery if desired of at least 15 gallons of oil per acre.

The cost of spray and dust application by airplane to relatively large areas compares favorably with the cost of hand or power application. Under most conditions it would probably be cheaper and better to contract with established concerns for airplane dusting or spraying.

Various commercial companies make a business of applying insecticides by airplane. A list of such companies will be supplied on request. Plans of hopper construction for use of dusts were developed by the Bureau some years ago and will be supplied to those concerned with application of insecticidal dust from the air. Recent experience has developed improvements for the distribution of certain kinds of insecticidal materials and such information may be made available through correspondence or consultation.

FUMIGATION EQUIPMENT

The equipment required in connection with fumigation operations is adequately discussed in Defense Circular 22--"Fumigation," which should be consulted for any information desired on this subject.

FLY TRAPS

Fly trapping is a supplementary measure of fly control and affords only partial relief. Completely satisfactory results are obtained only when measures to prevent fly breeding accompany trapping.

For manufacturers and distributors of fly traps, see Nos. 39, 46, 50, 53, 84, 89, 99, and 100 of list on pages 51-55 of this circular.

Special Eye Gnat Traps

Traps of a special design for use against eye gnats (Hippelates) are described and figured in Circular 8 on "Flies." If further information on this type of trap is required, it may be obtained from the Bureau of Entomology and Plant Quarantine.

Conical Type Fly Trap

The conical type trap has proved to be most satisfactory for catching house flies and blowflies. Of the various kinds of conical traps, those of all-metal construction are most desirable, although they can be made of hoops, laths, and screen, as shown in figure 6 of Circular 8. The cost of such traps when purchased ready-made varies from about \$2.00 to \$3.00, but they can be constructed by hand. Details of construction may be varied but the dimensions and general features of the trap should not be changed from those presented in the following directions and working drawing, (fig. 24).

The bait pan to be placed under the trap should be 1 inch deep and about 4 inches less in diameter than the base of the cone. When used to catch blowflies the legs of the trap should be blocked up to give about a 2-inch clearance under the trap.

Specifications for metal conical fly trap:

Dimensions: As per working drawing (fig. 24).

Wire: 14-mesh galvanized or preferably copper screen wire.

Cylinder: Wire gauze, to be soldered completely around inside of top ring and at intervals of 2 inches or less in groove of bottom ring. Vertical seam to be soldered entire and placed behind one leg. Where shipment of traps is not contemplated, the diameter of the top of the cylinder may be the same as that of the bottom.

Top: Wire gauze to be soldered completely around periphery on inside of top ring.

Cone: Wire gauze to be soldered completely around inside of cone ring and vertically along seam. A 1-inch inlet hole shall be formed at apex of cone.

Frame: To be made of 24-gauge galvanized iron. This includes top and bottom rings and legs.

Legs: Galvanized-iron channels made as per detailed drawing and secured to top and bottom rings with four rivets, 1/8 inch in diameter, to each leg. First turned and drilled as per drawing.

Bottom cylinder ring: J shaped, with bottom edge of cylinder dropped into J, crimped and soldered to secure. Ends of ring riveted to secure.

Cone ring: Galvanized-iron band with 3/16-inch round iron wire rolled into lower edge, as per cross-section drawing of "cone ring."

Wing nuts: Four copper wing bolts and nuts, as per drawing, to hold cone securely in place.

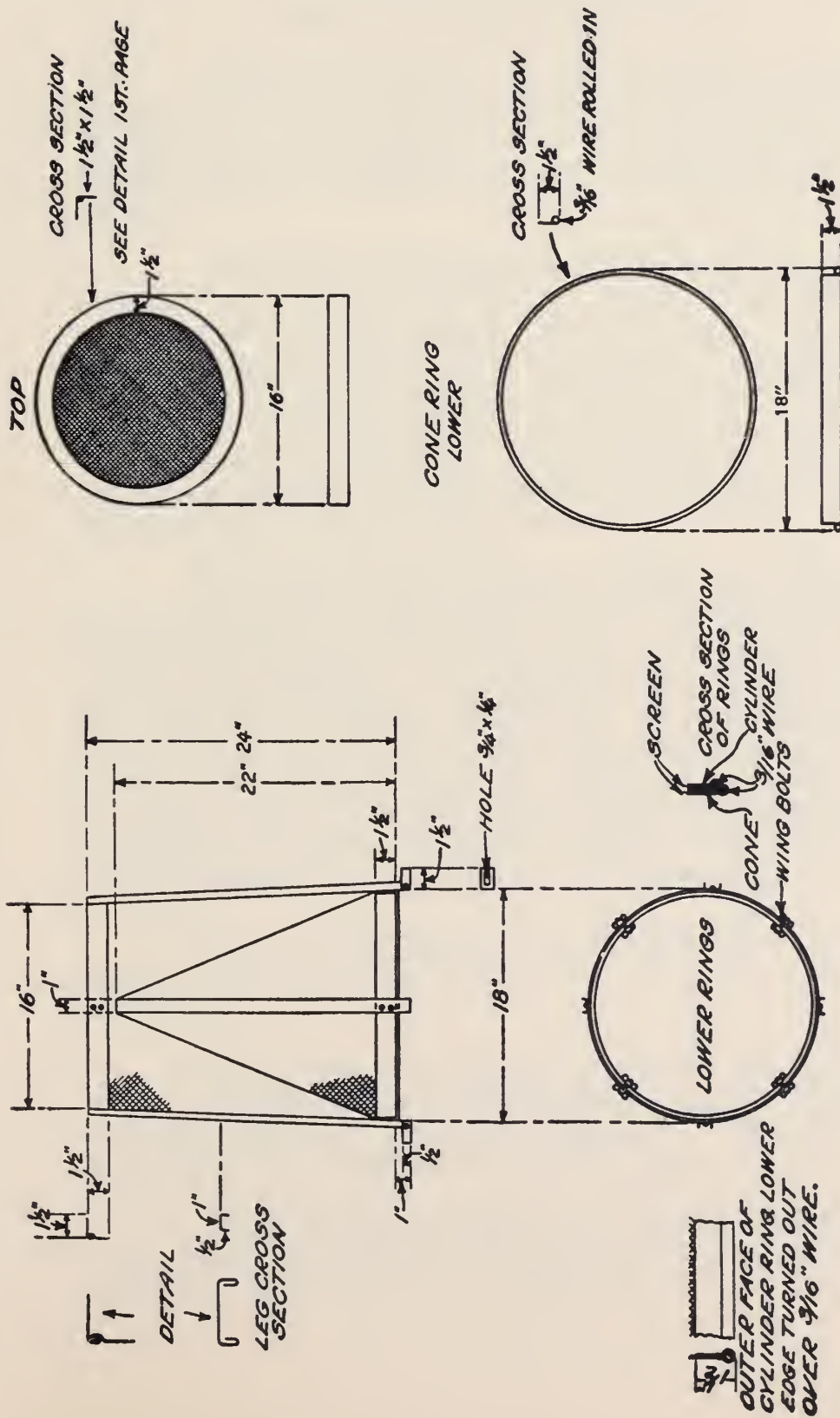


Figure 24.--Working drawings of all-metal fly trap. The cones are removable and traps and cones can be telescoped for shipment. The trap may be made 18 inches in diameter at the top as well as at the bottom if traps are not to be nested for shipping.

WIRE CLOTH FOR SCREENING

Wire cloth is widely used for screening doors and windows for protection against insects. It is used in the construction of many kinds of insect traps, especially fly traps.

The most satisfactory insect screen cloth for use in the humid tropics is made 16 or preferably 18 meshes to the inch of cold drawn copper wire, 0.0113 inch in diameter. The wire should contain 99.8 percent copper and have a lead and tin content not to exceed 0.05 percent of each. Wire cloth is also made of monel metal, which is satisfactory for screening in the tropics.

The warp and filler wires in galvanized and painted or japanned wire cloth may be of slightly different diameters but should average 0.0110 inch, the measurement to be based on the wire before coating. Galvanized wire should be coated by the electrolytic method with zinc of at least 98 percent purity. In very dry climates high grade painted or japanned insect screen cloth is often as satisfactory as galvanized screening.

The permissible variation in wire diameter of all screen cloth shall be 0.0005 inch.

The Federal specifications as approved by the Director of Procurement cover insect screen cloth of various types. See General Schedule of Supplies, Class 42-C.

For manufacturers and distributors see also Nos. 64, 69, 77, 96, and 102 of list on pages 51-55 of this circular.

INSECT ELECTROCUTORS

Electrocuting devices are available which will kill all insects that strike them. They are especially useful in combating house-flies. They usually contain a transformer which changes the ordinary house current to

one of low amperage and high voltage, 3500 to 4000 volts, which passes through the electrocuting element. When an insect comes in contact with the current conductor it is immediately killed. Various types are available which are adapted to specific uses. Some are made in the form of a screen or grid which is suitable for hanging on screen doors or windows (fig. 25). Others in the form of trapping devices are suited for use outdoors.



Figure 25.--Electrocutor and transformer installed on screen door to kill flies and other insects

For manufacturers and distributors see Nos. 14, 16, 17, 26, 30, 31, 33, 40, 42, 47, 58, 59, 63, 73, 76, 78, and 101 of list on pages 51-55 of this circular.

RESPIRATORS

Respirators of various kinds are worn over the face as a protection against inhaling poison dusts such as paris green and other dry insecticides. The body of the respirator is usually made of airproof and waterproof fabric or rubber, fitted with a respirator portion directly over the mouth and nose made of special fabric, which in some cases can be moistened, so that it will filter the very finest particles. Extra layers of gauze are sometimes placed inside of the respirator as an added precaution against irritating dusts. The gauze should be replaced twice daily if the respirator is in continuous use. Some kinds are fitted with a chin rest to make them more comfortable to wear. Elastic bands should be so arranged as to go under the ear, thus reducing the risk of skin irritation. There are various types suited for the different kinds of dusts.

For manufacturers and distributors see Nos. 6, 11, 20, 23, 45, 54, 56, 57, 74, 85, 88, 103, and 105 of list on pages 51-55 of this circular.

DUST GOGGLES

Goggles of various types are now available for the protection of the eyes, and may be especially useful when applying insecticidal dusts. For protection against dust and flying particles, goggles should be constructed to have snug fitting eye cups, with indirect ventilation to avoid fogging of the inner lens surfaces, and should be equipped with clear, protective lenses.

For manufacturers and distributors of dust goggles, see Nos. 6, 20, 45, 54, 57, 74, 85, 88, 103, and 105 of list on pages 51-55 of this circular.

TARPAULINS, RUBBERIZED

Rubberized tarpaulins are often useful for such purposes as covering piles of food-stuffs, supplies, and equipment, especially in fumigating, spraying, or dusting operations when it is not convenient or desirable to treat the entire room or building. They are also used for covering ricks of manure for their protection and to prevent fly-breeding in them. Such tarpaulins are available in a large number of sizes to meet different needs. Canvas or duck of from 8 to 25 ounces per square yard makes a good fabric base for rubberized and other tarpaulins. The weight of tarpaulin desirable will depend on the need. The ruggedness and wearing qualities of a tarpaulin increase in general with the weight of material, provided other factors of construction are equal. Seams and hems should be double or triple stitched and of good width. If eyelets are specified, they should be of brass and set in reinforced patches. Triangular corner patches, double sewed, may be a desirable point of construction.

For manufacturers and distributors see Nos. 21, 83, and 98 of list on pages 51-55 of this circular.

GLOVES AND APRONS

Certain chemicals like orthodichlorobenzene, coal-tar creosote, and pentachlorophenol are likely to burn or otherwise irritate the skin while being used as for powder post beetle and termite control. The body should be adequately protected by wearing rubberized fabric or neoprene treated gloves and aprons when working with such materials.

For manufacturer and distributor of neoprene-treated gloves and aprons see No. 5 on page 51 of this circular.

MISCELLANEOUS DEVICES

There are many other devices mentioned in the various Defense Circulars which are often employed in connection with or supplemental to insect control operations. Included are such items as fly swatters, fly paper and ribbons, bed nets, fly-tight garbage pails, electric fans of various types to keep flies from kitchen work tables, exhaust fans to remove poisonous or objectionable fumes, tight containers for food, paint brushes for applying insecticides, forceps for removing screwworms and ticks from the body, tarred paper for covering manure piles, blow torches, thermometers, syringes for applying medicaments to insect bites, wrapping paper and heavy, tightly woven cotton bags for protecting meats, and paper and glass containers for poison baits used in ant control. Since all these are so well known, in common use, and readily available, they will not be discussed in this publication.

PROCUREMENT OF DEVICES FOR INSECT CONTROL

The accompanying list of manufacturers and distributors of products discussed above is included for the information of the users of this circular, without given or inferred guarantee of the reliability of the firms or endorsement of their individual products. No attempt has been made to make the list fully complete and no discrimination is intended or implied against firms whose names or products are not listed. It is possible, in addition, that many of the items discussed in this circular can be obtained in local stores.

List of Manufacturers and Distributors

- 1 Ace Wood Products Co., 1891 West 25th St.,
Cleveland, Ohio
- 2 AcmeLine, Inc., Traverse City, Michigan
- 3 Aggeler & Musser Seed Co., 652 Matteo St.,
Los Angeles, California
- 4 Agicide Laboratories, Inc., 4668 North
Teutonia Ave., Milwaukee, Wis.
- 5 American Anode, Inc., 60 Cherry Street,
Akron, Ohio
- 6 American Optical Co., Southbridge, Mass.
- 7 John Bean Mfg. Co., Lansing, Michigan;
San Jose, California
- 8 Binks Manufacturing Company, 3114 Carroll
Ave., Chicago, Ill.
- 9 Breuer Electric Mfg. Co., 5100 North
Ravenswood Ave., Chicago, Ill.
- 10 E. C. Brown Co., Rochester, N. Y.
- 11 E. D. Bullard Co., 275 Eighth St., San
Francisco, Calif.
- 12 Campbell & Budling, San Jose, Calif.
- 13 The Campbell-Hausfeld Co., 600 State Ave.,
Harrison, Ohio
- 14 Carroll Electric Co., Inc., 714 Twelfth
Street, N. W., Washington, D. C.

- 15 Central Rubber Products Co., 821 Broadway,
New York, N. Y.
- 16 Champion Electric Products Sales Co.,
Equitable Building, Los Angeles,
California
- 17 Chicago Electric Scientific Co., 722 South
Summit Ave., Villa Park, Ill.
- 18 Chipman Chemical Co., Inc., Bound Brook, N.J.
- 19 Continental Can Co., 100 East 42d Street,
New York, N. Y.
- 20 H. S. Cover, Station A, South Bend, Ind.
- 21 Crawford Mfg. Co., Inc., Third and Decatur
Streets, Richmond, Virginia
- 22 Daisy Company, 507-11 East 116th Street,
Kansas City, Mo.
- 23 Davis Emergency Equipment Co., 55 Van Dam
Street, New York, N. Y.
- 24 The J. H. Day Co., 1144 Harrison Ave.,
Cincinnati, Ohio
- 25 The Deming Company, Salem, Ohio
- 26 Detjen Corporation, 303 West 42d Street,
New York, N. Y.
- 27 DeVilbiss Company, 300 Phillips Ave.,
Toledo, Ohio
- 28 Dobbins Manufacturing Co., North St. Paul,
Minn.
- 29 Dula Mfg. Co., Inc., 351 Atlantic Ave.,
Brooklyn, N. Y.
- 30 Eikco Insect Killer Co., 53 West Jackson
Boulevard, Chicago, Ill.
- 31 Electric Screen Products Corp., 411 West
Indiana Ave., South Bend, Ind.
- 32 Electric Sprayit Co., Colfax Street,
South Bend, Ind.
- 33 Electrified Screen Sales Co., Chicago, Ill.
- 34 Essick Machinery Co., 1928 Santa Fe Ave.,
Los Angeles, Calif.
- 35 Exterminating Materials Co., 712 Amsterdam
Avenue, New York, N. Y.
- 36 Feeny Manufacturing Co., Muncie, Indiana

- 37 Field Force Pump Co., Elmira, N. Y.
- 38 Fitzhenry-Guptill Co., 135 First Street,
East Cambridge, Mass.
- 39 The Fly Trap Shop, Richfield Station,
Minneapolis, Minn.
- 40 Folmer Electracyde Corp., 135 Mill St.,
Rochester, N. Y.
- 41 "Friend" Mfg. Co., Gasport, New York
- 42 Frost Electric Screen Sales Co., 6 North
Michigan Ave., Chicago, Ill.
- 43 Frost Insecticide Co., Arlington, Mass.
- 44 Funeral Company, Racine, Wisconsin
- 45 General Scientific Industries, 2735 No.
Broad St., Philadelphia, Pa.
- 46 Gilmore Hardware Co., Sonora, Texas
- 47 Joseph D. Grigsby, Manufacturers' Agent,
5201 Colorado Ave., N. W.,
Washington, D. C.
- 48 Hackney Chemical Co., Fresno, Calif.
- 49 The Hardie Mfg. Co., Hudson, Mich.
- 50 Hirst's Planing Mill, Leesburg, Va.
- 51 Thomas W. Houchin Corp., 87 Ferry Street,
Jersey City, N. J.
- 52 H. D. Hudson Mfg. Co., 589 East Illinois
Street, Chicago, Ill.
- 53 V. H. Humphrey, Humphrey Hardware Co.,
Eldorado, Texas
- 54 Hygeia Respirator Co., 532 East 82nd St.,
New York, N. Y.
- 55 Imperial Brass Mfg. Co., 1200 West
Harrison St., Chicago, Ill.
- 56 Industrial Products Co., 1001 Chestnut
Street, Philadelphia, Pa.
- 57 Industrial Safety Corp., 104 Franklin
Street, New York, N. Y.
- 58 Insect Electrocutor Co., Sycamore, Ill.
- 59 Insect Electrocutor Company, Spokane, Wash.
- 60 International Verminator Co., Chicago, Ill.
- 61 Jaeckh Mfg. Co., 3444 Colerain Avenue,
Cincinnati, Ohio

- 62 Johnson Gear and Machine Works, Fresno,
California
- 63 The Kawneer Company, Niles, Michigan
- 64 R. L. Latimer Co., 24 North Front Street,
Philadelphia, Pa.
- 65 P. E. Lirio, Vineland, N. J.
- 66 Los Angeles Chemical Co., 1960 Santa Fe
Ave., Los Angeles, Calif.
- 67 Lowell Manufacturing Co., Lowell, Mich.;
North Pier Terminal, Chicago, Ill.
- 68 Lowell Sprayer Co., Lowell, Michigan
- 69 Ludlow Saylor Wire Co., 600 South Newstead
Street, St. Louis, Mo.
- 70 Master Fan Corporation, 1321-35 Channing
Street, Los Angeles, Calif.
- 71 Messinger Mfg. Co., Tatamy, Pennsylvania;
7 Water Street, New York, N. Y.
- 72 Metal Specialties Mfg. Co., 3208 Carroll
Avenue, Chicago, Ill.
- 73 Middlebury Electric Clock Co., Macomb, Ill.
- 74 Mine Safety Appliances Co., Braddock Ave.
and Thomas Blvd., Pittsburgh, Pa.
- 75 F. E. Myers & Bro. Co., Ashland, Ohio
- 76 National Electric Screen Co., 25-29 North
Peoria St., Chicago, Ill.
- 77 Newark Wire Cloth Co., 351 Verona Ave.,
Newark, N. J.
- 78 Newton Insect Light Co., 1915 East Van
Buren St., Phoenix, Arizona
- 79 Niagara Sprayer & Chemical Co., Inc.,
Middleport, N. Y.
- 80 Nico Dust Mfg. Co., 2412 E. 57th St.,
Los Angeles, Calif.
- 81 Olson Bros., Kingsburg, Calif.
- 82 Peerless Dust Gun Co., 5100 St. Clair Ave.,
Cleveland, Ohio
- 83 Pioneer Rubber Mills, 353 Sacramento St.,
San Francisco, Calif.
- 84 Popkins & James, Purcellville, Virginia

- 85 Pulmosan Safety Equipment Corp., 174
Johnson St., Brooklyn, N. Y.
- 86 Paul O. Roediger, P. O. Box 383, Prince-
ton, New Jersey
- 87 The Root Manufacturing Co., 1051 Power
Avenue, Cleveland, Ohio
- 88 Safety Engineering Co., 15 Park Row,
New York, N. Y.
- 89 Schandua & Reichenau, Fredericksburg, Texas
- 90 Shunk Manufacturing Co., Bucyrus, Ohio
- 91 Simmons Paint Spray Brush Co., Dayton, O.
- 92 D. B. Smith & Co., Inc., 414 Main Street,
Utica, N. Y.
- 93 Spraco, Inc., 114 Central St., Somerville,
Mass.
- 94 Stauffer Chemical Co., Inc., 420 Lexington
Avenue, New York, N. Y.
- 95 The Tanglefoot Co., Grand Rapids, Mich.
- 96 W. S. Tyler Co., 3621 Superior Bldg., N.E.,
Cleveland, Ohio
- 97 Universal Power Sprayer Co., Inc.,
Plymouth, Michigan
- 98 Universal Rubber Mfg. Co., 958 Harrison
Street, San Francisco, California
- 99 Veihl-Crawford Hardware Co., Inc.,
1605 Main St., Fort Worth, Texas
- 100 Wendland Metal Works, San Angelo, Texas
- 101 Westinghouse Lamp Co., Bloomfield, N. J.
- 102 Wickwire Spencer Steel Co., 41 East 42nd
Street, New York, N. Y.
- 103 Willson Products Co., Inc., Reading, Pa.
- 104 Andrew Wilson, Inc., Springfield, N. J.
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